

TOLL COLLECTION SYSTEM AND FREEWAY TRAFFIC MANAGEMENT SYSTEM IN INCHEON BRIDGE PROJECT

Kwang-Ayoul Moon

Senior Project Manager, Samsung SDS Co., Ltd.
steven.moon@samsung.com

Oi-Cheol Ma

General Manager, Seoyeong Engineering Co., Ltd.
ocma@seoyeong.co.kr

Jong-Ho Yang

General Manager, Samsung C&T Corporation Co., Ltd.
yjhgen@samsung.com

Young-Jae Choi

General Manager, Samsung C&T Corporation Co., Ltd.
youngjae.choi@samsung.com

Bong-Soo Jang

Executive Manager, Incheon Bridge Co., Ltd
bongsoo.jang@samsung.com

Jung-Tae Lee

Senior Manager, Korea Expressway Corporation
ljt9911@ex.co.kr

Abstract: *Incheon Bridge is a long, large-scale bridge that is installed at sea to provide convenience and promptness for users on bridge. To do so, information on traffic accident risk and weather change should be promptly delivered to users and the ultimate goal of FTMS is to accurately inform the users with situations on Incheon Bridge and to prevent secondary accidents. Furthermore, it has a significant function of selecting the route to the Incheon International Airport by accurately delivering the situation of Incheon Bridge to drivers who are expected to use the Incheon Bridge from the Second Kyungin Expressway and National Road.*

In addition, in terms of toll collection, it should be able to provide accuracy of 99.9% on vehicle classification for sales inspection. As a high-tech system that is operated for 24 hours, it should ensure reliability, prevent violation, provide easy operation of equipments and so on to maximize the efficiency of operation. For drivers especially using Incheon Bridge Toll Booths, various toll payment means (cash, Hi-Pass Card, Deferred Hi-Pass Card) should be provided to minimize delay at toll booths which results in the highest satisfaction of customers and this is the important matter.

Keywords: *tcs, ftms, its, safety, convenience, efficiency of operation, toll payment means*

1. TOLL COLLECTION SYSTEM OVERVIEW

Toll Collection System is applied to minimize the inconvenience of toll payment that is caused on toll road and the delay/congestion. By increasing the functionality of toll road by constructing MIS, eradicating injustice of fare collectors and so on, the toll plaza work is simplified. At the same time, domestic/international examples of toll collection system are reviewed to be applied as the design standards on TCS, site equipments such as Enforcement Camera System, Toll Plaza System and etc.

Moreover, sales system of discount, exemption, vehicle classification and operation plan on toll collection system such as toll payment means of cash, credit card and so on and advance/deferred payment methods, toll settlement and etc are reviewed. The system is configured for efficient operation of relevant equipments and easy maintenance. By considering the characteristics of lane equipments, information providing equipments, controlling equipments and overloaded vehicle detection system, the system is structured to ensure road maintenance and safe driving environment.

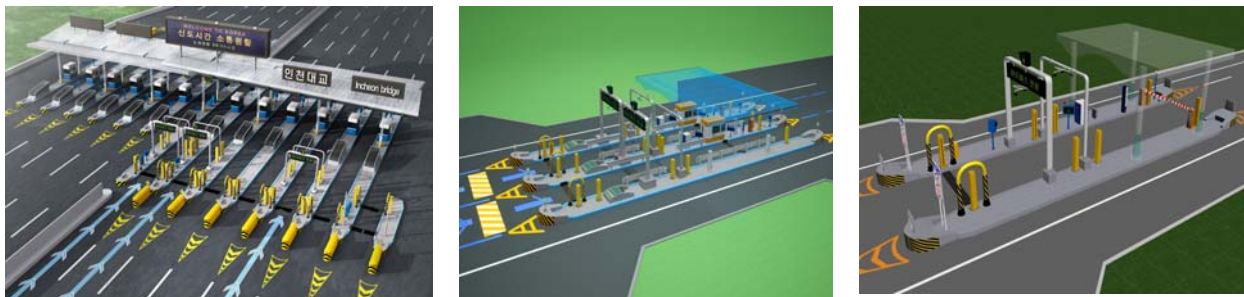


Figure 1: Operation of Incheon Bridge Toll Booth

1.1 History of Toll Collection

Since the construction of highways in 1970s, our toll collection method has evolved largely in 3 stages. In 1970s~1980s, the user paid the fare to the destination at the entrance toll booth and submitted its receipt at the destination. In 1990s, the number of vehicles on road constantly increased. So without limiting the solution by only expanding highways, the necessity of change in toll collection method(change to deferred payment) was recognized which led to configuration of system that issues the ticket automatically and auto toll collection system. However, the increase of vehicles due to improvement of life quality showed limitation of highways. This resulted in introduction of Hi-Pass System which is an automatic toll collection system that enhances the efficiency of highway usage.



Figure 2: History of Toll Gate

1.2 Case Study of System (Korea Expressway Corporation)

There are 13 open toll collection plazas with 196 lanes and 249 close toll collection plazas with 1,659 lanes in nationwide 2,850km (based on 31th January, 2008)

Standard of Close / Open

Classification	Close	Open
Standard	<ul style="list-style-type: none"> Long access and exit distance, multi-lane roads Many vehicles to travel long-distance 	<ul style="list-style-type: none"> Short access and exit distance, (metropolitan areas) Many vehicles to travel short-distance
Lanes	<ul style="list-style-type: none"> Gyeongbu, Central, Yeongdong Expressway 	<ul style="list-style-type: none"> Seoul Outer Circulation Express Private Investment Roads (Incheon Airport Highway, Kwang-an Bridge, Gwangju second Circulation Express)
Characteristics	<ul style="list-style-type: none"> Fair toll burden Convenient for long distance travelers 	<ul style="list-style-type: none"> Smooth traffic on access and exit road Reduce facility investment and management costs

Standard of Vehicle Types

Vehicle Types		Classification Standard
Small Car	Class 1	<ul style="list-style-type: none"> 2 axle vehicles, tire width above 130mm ~ below 279.4mm passenger car, 16-seater mini-bus Under 2.5 ton small truck
	Class 2	<ul style="list-style-type: none"> 2 axle vehicles, tire(width) above 279.4mm, length above 1,370mm~ below 1,800mm 17 ~ 32-seater medium size bus 2.5 ~ below 5.5 ton truck
Medium Car	Class 3	<ul style="list-style-type: none"> 2 axle vehicles, tire(width) above 279.4mm, length above 1800mm Over 33-seater large bus 5.5 ~ below 10 ton truck
	Class 4	<ul style="list-style-type: none"> 3 axle vehicles 10 ~ below 20 ton truck
Large Car	Class 5	<ul style="list-style-type: none"> 4 axle vehicles, above 20 ton truck
	Class 6	<ul style="list-style-type: none"> 2 axle vehicles, tire(width) below 130mm, length below 1,340mm Compact car <p>(Total length 3.6m or less, 1000cc compact car in this business exception)</p>

Payment Methods

- Toll collection methods: manned machine system
- Payment methods: cash, highway pass card, exemption card, credit card
- Types of highway pass card: 10,000 KRW, 20,000 KRW, 30,000 KRW, 50,000 KRW, 100,000 KRW, 1 ~ 3% discount, discount 50% for a compact car (displacement: below 800cc)

Overweight Vehicle Enforcement System

Some fixed weight in motion wheel load scales are operated in parts of access and exit road for open TCS areas and fixed weight in motion wheel load scales are operated in the entrance of 1~2 lane(s) for close TCS areas. Currently 8 truck scales are operated and 49 mobile weight in motion wheel load scales are operated. Conforms to road law article 54, same law enforcement ordinance the 28th 3 for road surface damage prevention by limitation traffic of expressway and is restricting running of vehicles. Prosecution standard of overcharge vehicles axle load 11ton exceed or GWT is 44t. It when exceed be, and when prosecutes, is placed in penal servitude fewer than 1 year or fewer than 2 million won according to road law article 83

Enforcement Camera System / Preventing Runaway Vehicle System

Operate preventing runaway vehicle systems to nip the bud of nonpayment toll from 2002 by adding recognition of a plate number to a enforcement camera system in metropolitan and local areas. After confirming runaway vehicles, issue nonpayment toll bills. The fine is consisted of the longest toll fair from the toll plaza plus 10 times of additional fair (article 32-3 of guideline of operation) . Operate a preventing delinquent tax system based on 'operational guideline of delinquent tax' by adding plate number recognition to enforced collection of delinquent taxes

Electronic Payment System

When the user is paying the fare in cash, it requires much time (about 8 seconds) which causes delay at toll booth. Therefore, electronic payment system that enables the driver to use the prepaid/deferred card to directly pay the toll fee is structured. This is currently being operated by KEC which solves the delay at toll booth by reducing the payment time to 3~4 seconds from 11 seconds before.

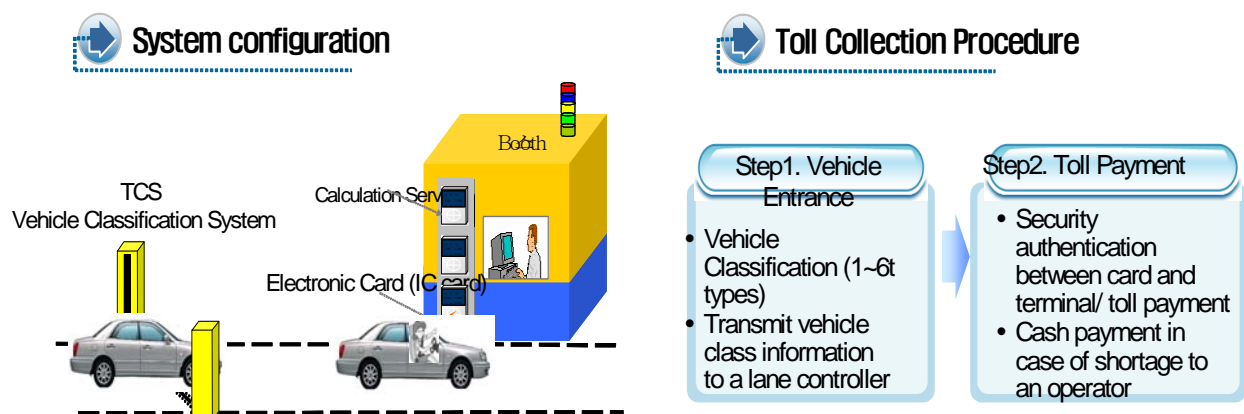


Figure 3 Flow Chart on E-Payment/Collection

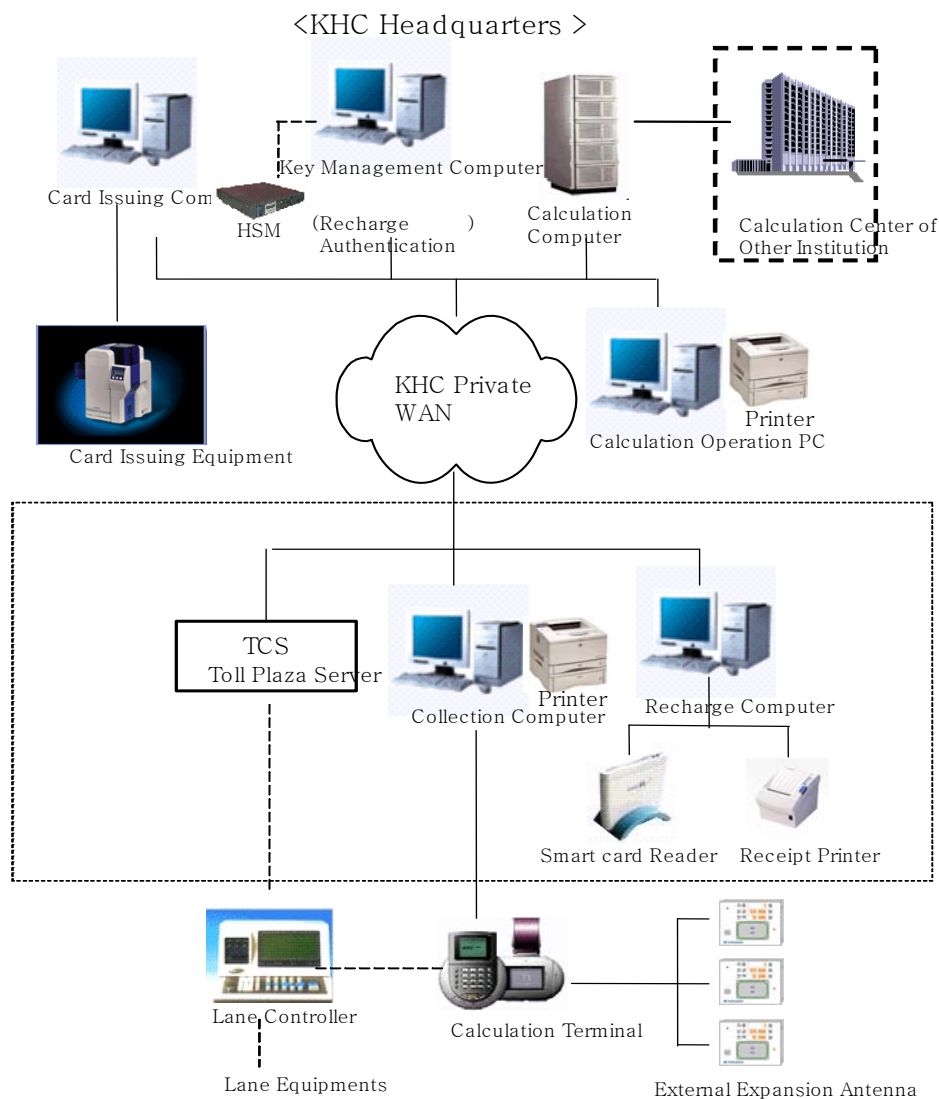


Figure 4 TCS & ETC Network Diagram

1.3 Toll Collection System of Incheon Bridge

Incheon Bridge is a gateway to South Korea and to prevent the delay at toll booth in advance, efficient operation of toll booth and various toll payment means should be accommodated for the domestic/international users. In addition, accuracy of vehicle classification should be increased for accurate sales inspection and in case of system error verified system should be structured to immediately recover any failures.

1.3.1 Toll Plaza Lane Estimation

The number of lanes needed for a toll plaza is determined on the basis of traffic (entrance interval), average service time, and service standard (average waiting cars).

Two way TCS 10 lanes and ETCS 2, Mixed Lane 1 lane, calculated by handling capacity calculation, service time, average waiting cars, and number of handled cars.

Note) This result is the data of traffic calculation company, and this document only deals with basic contents.

To item to decide through operation burden and organizations concerned enough conference after extension plan of ETCS road and reappraisal of traffic demand analysis subject is preceded, that

businessman part that is added going through design change (design and construction) in case of amendment happens late order. (only, additional expense by design change is expected)

Calculation of handling capacity per booth for ETCS and TCS

Classification	Lane Operation	Service Time	Handling Capacity per Booth
ETCS	2 lane	3.0sec	1,200 vehicle/hour
TCS+ETCS	1 lane	3.0sec or 8.0sec	1,200 vehicle/hour , 397 vehicle/hour
TCS	4 lanes	8.0sec	397 vehicle/hour (4 lanes : 1,588 vehicle/hour)
Remark	Total 7 lanes	-	Total (4,385/ 5,188) vehicle/hour
Note)	1. Handling capacity per booth of ETCS is 1,200 vehicle/hour with crossing gate (barrier), and 1,800 vehicle/hour without crossing gate. (Source: Analysis on the effect of Hi-pass expansion on the metropolitan area after 100 days(Mar. 2006), MOCT, KHC) 2. Handling capacity per TCS booth with 1.0 average waiting car and 8.0 service time makes the handled cars conforming to the TCS lanes. (Source: Road Design Vol. 1, Chap. 3-3 Toll Plaza, KHC)		

Lanes, Service Time, Average waiting cars and Handled cars(vehicle/hour)

Service Time	Average waiting cars	6 sec.		8 sec.		14 sec.	
		1.0 vehicle	3.0 vehicles	1.0 vehicle	3.0 vehicles	1.0 vehicle	3.0 vehicles
Lanes							
1		300	450	230	340	130	190
2		850	1,040	640	780	360	440
3		1,420	1,630	1,070	1,230	610	700
4		2,000	2,230	1,500	1,670	860	960
5		2,590	2,830	1,940	2,120	1,110	1,210
6		3,180	3,430	2,380	2,570	1,360	1,470
7		3,770	4,020	2,830	3,020	1,620	1,720
8		4,360	4,630	3,270	3,470	1,870	1,980
9		4,960	5,220	3,720	3,920	2,130	2,240
10		5,560	5,820	4,170	4,370	2,380	2,490
11		6,150	6,420	4,610	4,820	2,640	2,750
12		6,740	7,020	5,050	5,270	2,890	3,010
13		7,340	7,620	5,510	5,720	3,150	3,270
14		7,940	8,220	5,954	6,170	3,400	3,520
15		8,530	8,820	6,400	6,620	3,660	3,780

1.3.1 Toll Collection Methods of Manned TCS & ETCS

Introduce smart card along with cash to collect toll smoothly and provide convenience to drivers

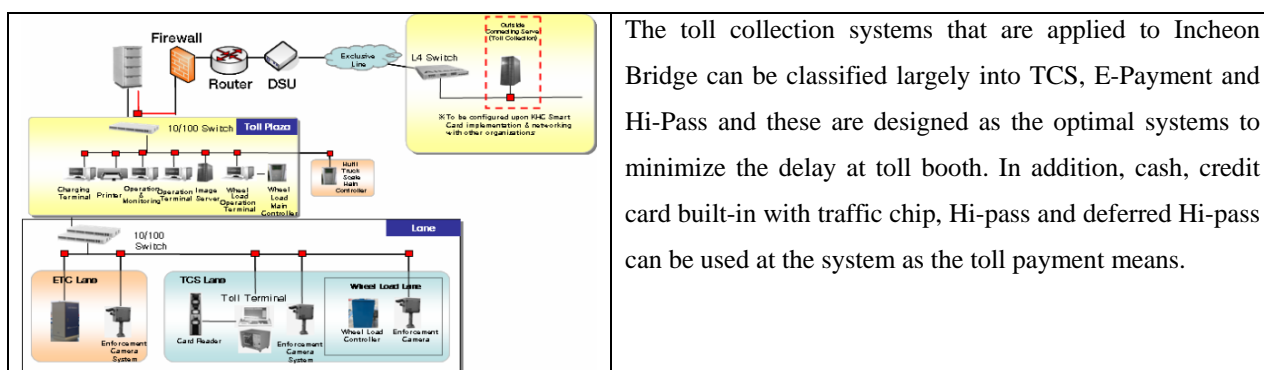


Figure 5 Toll Payment Media

1.3.2 Operation Flow

Operation	Details
Toll Collection	<ul style="list-style-type: none"> • Classify vehicle • Collect toll according to vehicle class and using payment method (cash, electronic money, etc.) • Record related information
Handling Special Vehicle	<ul style="list-style-type: none"> • Handle exemption / discount vehicles and record related information • Handle special vehicles and towing cars and record related information
Handling Violated Vehicle	<ul style="list-style-type: none"> • Handle runaway or disqualified vehicles and record related information
Investigation and Calculation	<ul style="list-style-type: none"> • Investigate daily operation status through operation reports, collection reports, handling violated vehicles reports and calculation process

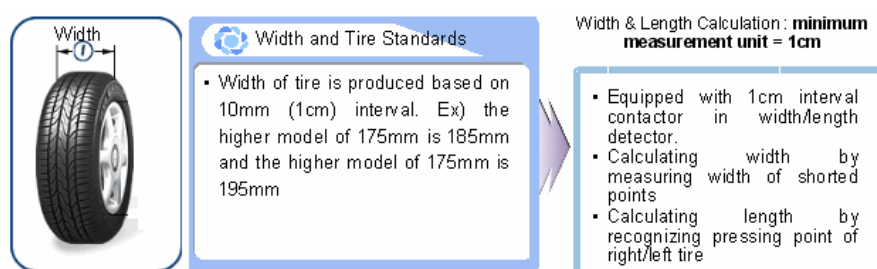
System Configuration



1.3.2 Vehicle Classification

Vehicle classification applied domestically is based on 6-type system of KEC and 4 classes of vehicles are applied on Incheon Bridge – sub-compact car, compact car, medium-sized car, large-sized car. This system enables classification of vehicles using wheel width, tread, length and etc as shown on Figure 6 [Vehicle Classification Mechanism].

Figure 6 Vehicle Classification Mechanism



1.3.3 E-Payment

The cards used for e-payment can be divided into KEC Hi-Pass Card, KEC Deferred Card, Credit Card built-in with traffic chip and so on and it is installed in 3 columns so that the fare can be paid in accordance to vehicle type as shown on Figure 7 [E-Payment Operation Plan for Users].

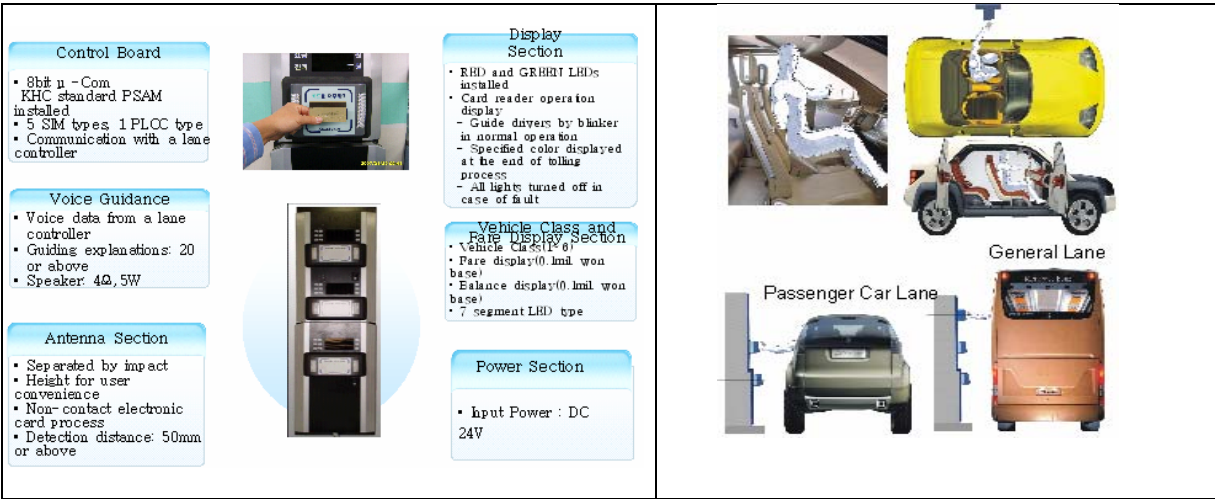


Figure 7 E-Payment Operation Plan for Users

1.3.4 ETCS

The Hi-Pass Systems constructed on Incheon Bridge are at 3 lanes each in upward and downward direction with total of 6 lanes. If the user is willing to use the Hi-Pass, OBU which is the separate vehicle terminal should be purchased and installed in the vehicle. Then, purchase a Hi-Plus Card, charge it to be used on Hi-Pass Lane. The Hi-Pass System consists of 2 antennas and based on the OBU type that can currently be used domestically, RF Type and IR Type Dual is structured so that the toll fee can be collected from any OBU.

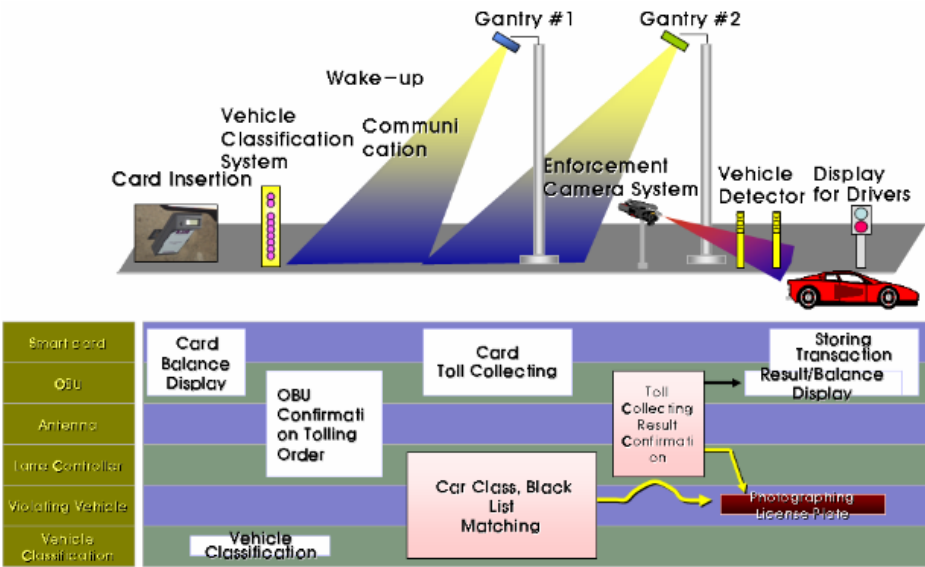


Figure 8 ETCS Toll Collection Process

Fare Payment

Both the prepaid method and the postpaid method available and Operable with rush hour, weekdays, weekends (extra fare), and late-night (reduced fare) by vehicle class
Regular fare receipt available in case of facilities failure excluding the minimal facilities related to the fare receipt (lane controller, communication antenna)

Special Vehicle Management

Violations are classified into OBU not attached, OBU failure, balance shortage, faulty card, card not inserted, wrong card insertion, card expiration, discord of classification, etc.

The license plates of violated vehicles are photographed to collect penalties and drivers and toll plaza workers are alarmed.

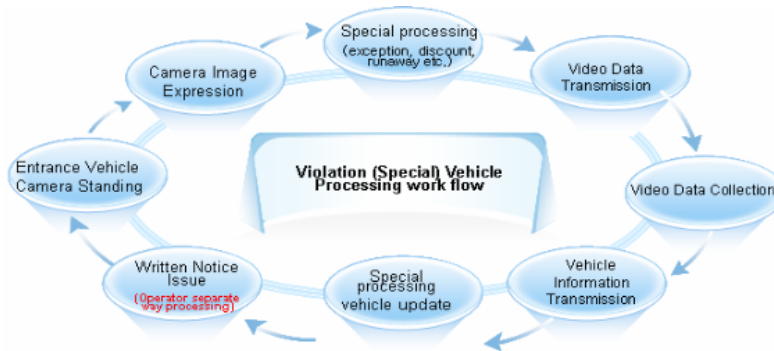


Figure 9 Special Vehicle Management Of ETCS

Exempted vehicles (※ Wide application and enforcement plan of exemption vehicles are decision item of operation subject.)

Exempted vehicles include military operational vehicles, fire engines, ambulances, traffic control vehicles, vehicles to support men of national merit, business vehicles, and working vehicles.

Discount vehicles (※ Wide application and enforcement plan of discount vehicles are decision item of operation subject.)

2. ITS(Intelligent Transport System)

2.1 Overview

Incheon Bridge which is the toll road provides not only the simple traffic information but also disaster services to users. It is a system that values the safety of users, provides convenience for users by connecting information on neighboring roads and it is structured to fully reflect the compatibility with KEC and other connecting roads.

The system is operated by separating the project scope to private section and national section as shown on Figure 1 [Spatial Scope].

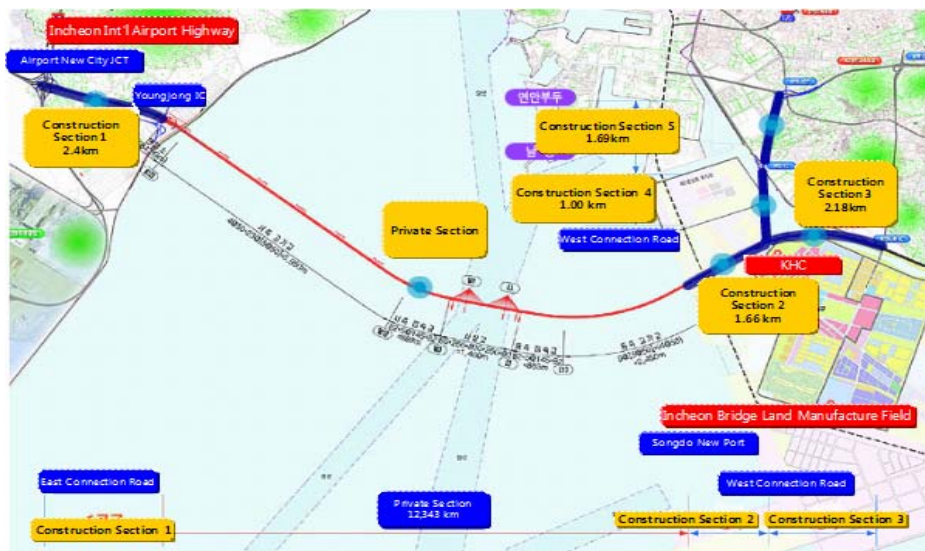


Figure 1. Spatial Scope

2.2 Traffic Environment

Roads that are directly linked to Incheon Bridge and connecting road are Incheon Bridge International Airport Highway(Airport New City JCT), Airport South Road(Youngjong IC), Songdo Coastal which is being extended(SongdoIC, Yeonsu JCT, Okryun IC), Kyungin Second Expressway(Hakik JCT) and etc. In addition, the main road networks near this project section and connecting road are Kyungin Expressway, Second Ring Road(expected), Kyungin Third Expressway(Expected), Youngdong Highway and etc. They are indirectly linked through neighboring street network



Figure 2. Traffic Environment

Name of Road	Number of lanes(two-way)	Breadth(m)	Connecting IC	Connecting Type
Incheon International Airport Highway	8	40.0m	Airport New City JCT	completely graded (Clover type)
Kyungin Second Expressway	6~8	30.0m	Hakik JCT	completely graded (Directional)
Songdo Coastal Road(Being extended)	12	75.0m	Yeonsu JCT	completely graded (Directional)
Songdo Coastal Road(Being extended)	12	75.0m	Songdo IC	completely graded (Directional)
Songdo Coastal Road(Being extended)	12	75.0m	Okryun IC	completely graded (Directional)
Airport South Road	4~5	20.0m	Youngjong IC	completely graded (Trumpet type)

2.3 Development on Traffic Volume of Main Road Network

From the main road network which is the basic data to predict the demand of this project lines, the traffic volume development on highway during the last 6 years is shown on the following table. Although there's a slight reduction of traffic volume on partial section for a certain period, the traffic volume of the nearby highway network has increased to 5.09% annually in average

Changes in Traffic Volume of Neighboring Highway Network for the Last 6 Years

Changes in Traffic Volume of Neighboring Highway Network for the Last 6 Years				
Name of Road	Section	Year	Traffic Volume(No./day)	Rate of Increase
Kyungin Expressway	Origin~Dohwa IC	2002	46,262	-
		2003	51,948	12.29
		2004	50,946	-1.93
		2005	52,854	3.75
		2006	53,743	1.68
		2007	60,855	13.23
Kyungin Second Expressway	Origin~Munhak IC	2002	66,696	-
		2003	66,955	0.39
		2004	67,506	0.82
		2005	71,246	5.54
		2006	72,015	1.08
		2007	77,960	8.26
Incheon International Airport Highway	Airport~Airport Entrance JCT	2002	42,273	-
		2003	42,285	0.03
		2004	45,817	8.35
		2005	47,712	4.14
		2006	50,095	4.99
		2007	49,189	-1.81
Average Rate of Increase				5.09

Source : MLTM, Statistical Annual Report on Road Traffic Volume for Each Year

2.4 Traffic Demand Prediction

Traffic demand prediction consists of processes that analyzes traffic phenomenon and predicts future traffic volume using the results drawn.

In case of future traffic plan that is relatively simple, rough demand prediction is possible. However, in case of large-scale projects such as this project, the range of influence on relevant roads is broad and since there are many variables to consider, it's recommended to use the traditional 4-stage prediction method.

The process of traffic demand prediction that uses general 4-stage prediction method is as the following.

Results on Traffic Demand Prediction

In case of private section which is the main section of results on demand predication, the average increase rate appears to be 25.7% for every 5 years resulting in 38,207 cars/day in 2010.

The average traffic volume of national section which includes in 2010 is 23,978 cars/day and the average increase rate is analyzed as 25.64% for every 5 years.

Demand from Youngjong IC ~ Songdo JC which is the main line section appears to be the highest and the next highest demand comes from Airport New City JC ~ Youngjong IC section which approaches from Incheon International Airport to Incheon Bridge. It can be identified that the new traffic volume that is caused due to performance of this project is above the regular level.

In case of traffic volume that is branched and collected through Songdo JC which is the junction for vehicles that uses main line section, it appears to be 20,361 cars/day and 17,846 cars/day and they are similar to the demand of main line. This phenomenon proves the contrary that the demand produced due to this project is not little.

Location	Airport New City JCT ~ Youngjong IC	Youngjong IC~ Songdo JC	Songdo JC~ SongdoIC	Songdo JC~ SongdoIC	SongdoIC~ Hakik JC	Average
2010	31,343	38,207	20,361	17,846	12,134	23,978
2014	38,144	45,884	24,844	21,040	14,394	28,861
2019	47,975	56,858	30,866	25,992	18,327	36,004
2029	79,270	96,435	55,407	41,028	28,751	60,178

Prospective Demand Prediction Results on Project Section (Unit: cars/day)

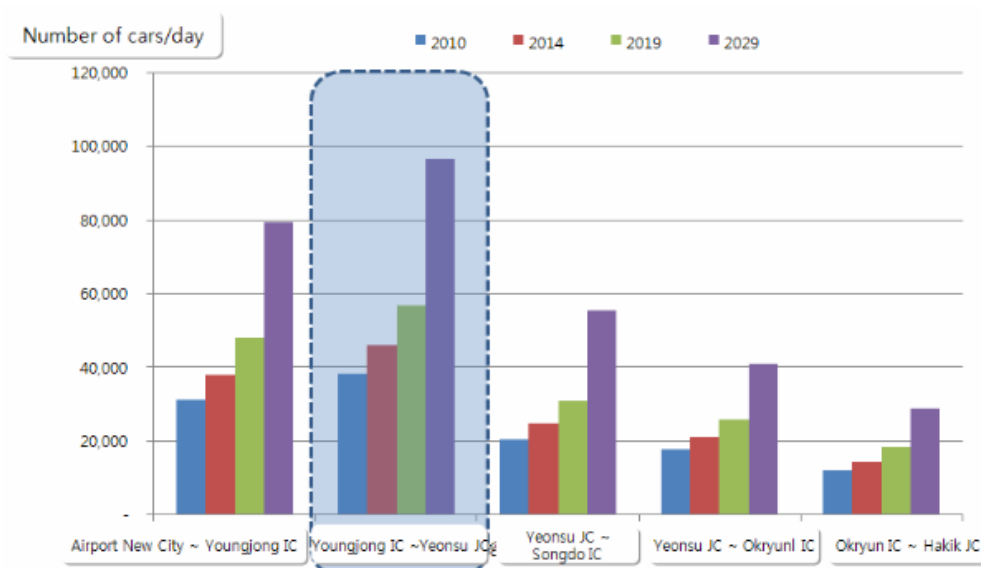


Figure 2. Results on Traffic Demand Prediction

2.5 Traffic Management Scope

Incheon Bridge private section road is a long and large bridge that connects Songdo and Yeongjongdo. As a road that is operated in integration with the national section on outskirts of Incheon for dispersion of city traffic demand and traffic inflow of Incheon International Airport and Yeongjongdo road, it's predicted that large amount of passing traffic volume which aggravated the traffic congestion of Incheon will be dispersed.

For this, spatial and contents scope of traffic flow management performance scope for efficient operation are set and suitable traffic flow management strategy is established in accordance to this. For the efficient traffic management, spatial scope is divided into direct management section and indirect management section to be managed.

- . Direct management section : Incheon Bridge private section highway and national section that will be integrated in the future
- . Indirect management section : KHC section(Kyungin Second Expressway, Seoul Ring Road, Kyungin Third Expressway(in the future)), Incheon International Airport highway section, city inflow/outflow connecting road connected to the national section

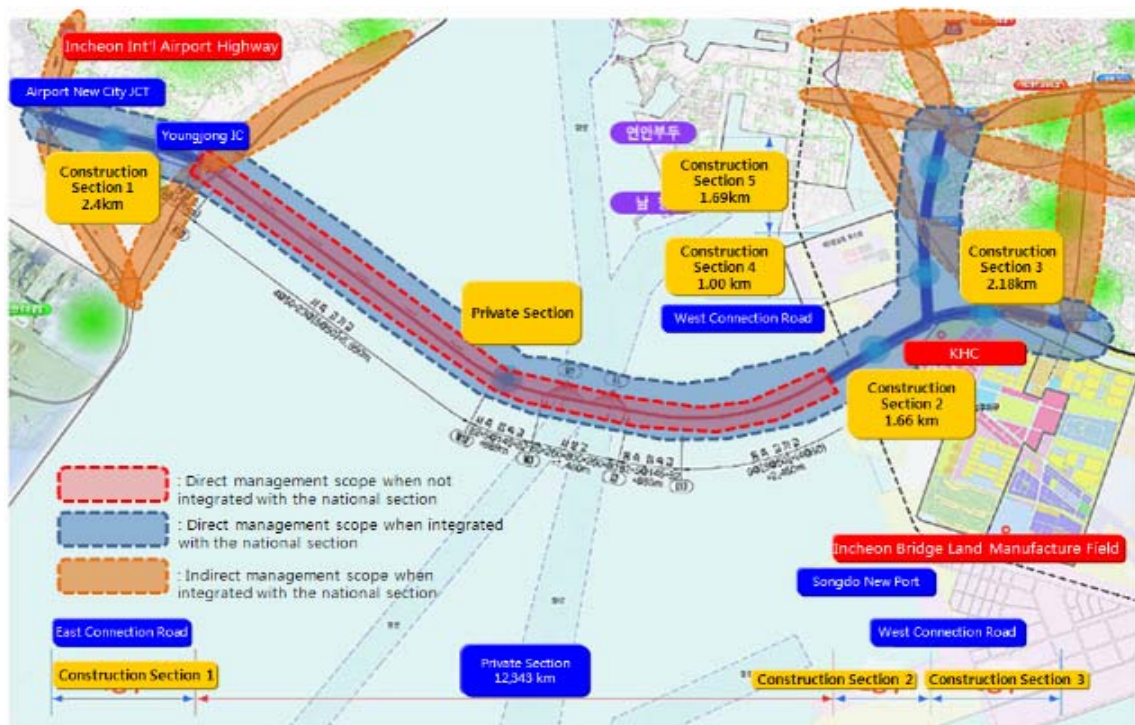


Figure 3. Traffic Management Scope

2.6 Traffic Information Collection Scope & Collection Media

Information collection scope is set within the spatial scope set on Incheon Bridge private section.

Direct information collection scope and collection media

- . Incheon Bridge bridge section: Traffic info. collection(VDS : video detector), image collection (CCTV), weather information collection(RWIS), patrol, information on driver report, etc.
- . National section & ramp: Collect when operated in integration with national section in the future
Information collection section through connection with MLTM national traffic information center (Collect information for detour when operated in integration with national section in the future)
- . KHC section: Kyungin Second Expressway(Hakik JCT ~ AnhyunJCT)
Seoul Ring Road(NoohjiJCT ~ AnhyunJCT)
- . Incheon International Airport Highway section(Airport New City JCT ~ NoohjiJCT)

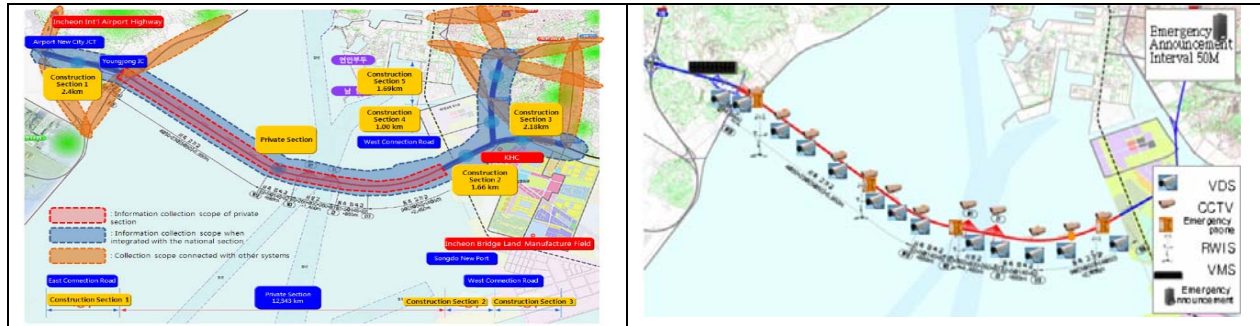


Figure 4. Traffic Information Collection Scope

2.7 Traffic Information Providing Scope & Provision Media

Information providing scope & provision media

- . Incheon Bridge private section: TSD, LCS, WEB, ARS/FAX, Traffic Broadcasting, Traffic Status Board, Emergency Broadcasting
- . National section ramp: Provided when integrated with national section in the future
Provide connection information on other system(Provide information for detour when operated in integration with national section in the future)
- . KHC section: Kyungin Second Expressway(Hakik JCT ~ AnhyunJCT)
Seoul Ring Road(NoohjiJCT ~ AnhyunJCT)
- . Incheon International Airport Highway section(Airport New City JCT ~ NoohjiJCT)

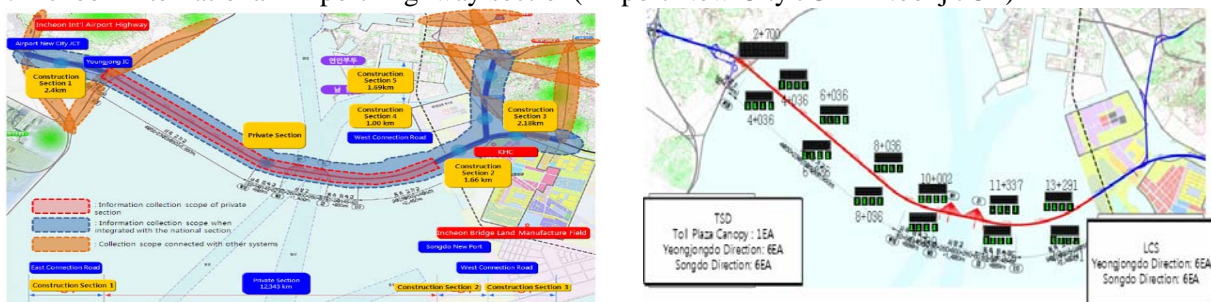


Figure 5. Traffic Information Providing Scope

2.8 Detour Management Strategy

When performing traffic management on Incheon Bridge Private Section, congestion, incident situation and special situation that are mentioned previously will occur and when congestion gets severe, perform detour management strategy to manage demand on upper stream part. But, roads that are relevant to detour management strategy for demand management on upper stream part should be sections where information collection is possible and it should be performed in proposition that it will be operated in integration with the national section in the future. Therefore, the detour roads of these highways are as the following.

- . KHC section: Kyungin Second Expressway(Hakin JCT ~ Anhyun JCT)
Seoul Ring Road(Noohji JCT ~ Anhyun JCT)
- . Incheon International Airport Highway section(Airport New City JCT ~ Noohji JCT)

Detour Management Strategy

Detour management is performed as shown below by each location where detour is possible for demand control on upper stream part of Incheon Bridge Private Highway section.

No.1 : Information on recommendation of detour to Incheon International Airport Highway is

- provided before approaching Airport New City JCT.
- No.2 : When approaching from Seoul Ring Road, information on recommendation of detour to Incheon International Airport Highway is provided ahead of Noohji JCT.
 - No.3 : When approaching from Kyungin Second Expressway, information on recommendation of detour to Incheon International Airport Highway is provided ahead of Anhyun JCT.
 - No.4 : When approaching from Seoul Ring Road, information on recommendation of detour to Incheon International Airport Highway is provided ahead of Anhyun JCT.
 - No.5 : On traffic inflow to Anhyun JCT, information on inhibiting approach to city road that is connected to Anhyun JCT and information on detour induction are provided.

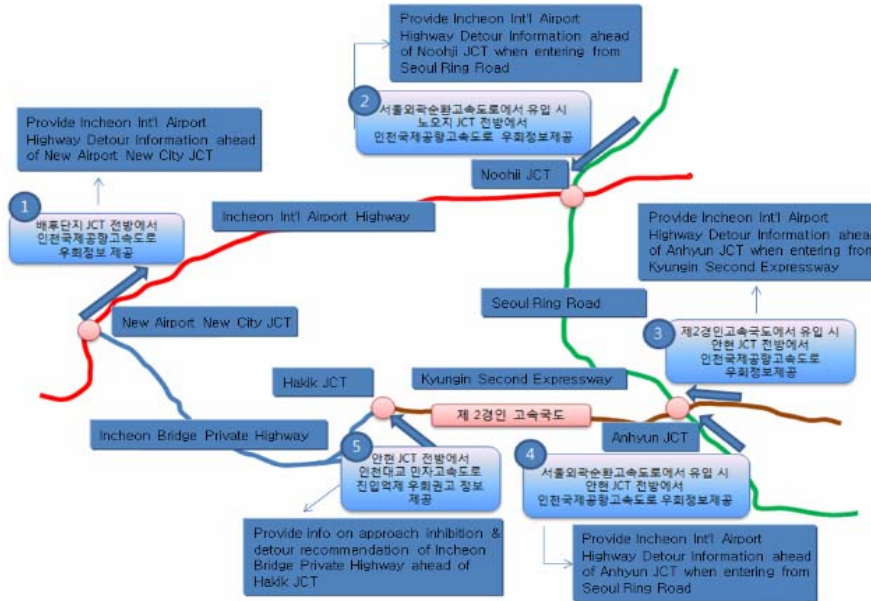


Figure 6. Detour Management Strategy by Location

2.9 Traffic Management Network System

Network system setting for the traffic management of Incheon Bridge Private Section is very significant for the smooth performance of information collection, processing and provision and for efficient incident management.

Network system is classified by and consisted of 3 levels in total and logic level is added especially for incident management.

Configuration on Node Link System by Level

Network system is consisted of 3 levels in total and as the basic node link system, there is level 1 which is based on all the physical network composite factors on road, level 2 which is based on detection that is responsible for collecting information and level 3 for providing information in general.

Controllable information providing link which is the logic node link system is a basic unit of controllable information provision for response in incident situations and it performs efficient incident management by providing information on vehicle detour and driving ahead through TSD. It also logically consists of the link system by each level through grouping based on Level 1 Link System.

A long and large bridge section is included in this highway section and measure for intensive traffic management is necessary. So by predicting sections where change in traffic flow may occur and congestions occur within the bridge section, it's necessary for them to be included in the node link system.

. Node link addition : Connecting section of West/East Approach Bridge, Elevated Bridge section

Level	Overview	Structure-based factor(Node)
1	<ul style="list-style-type: none"> Basic node/link system Based on all the physical network composite factors on road 	<ul style="list-style-type: none"> O-D(Origin-Destination) VDS TSD Road node(IC/JC/toll plaza and etc.) Bridge's west/east approach bridge, both end of elevated bridge
2	<ul style="list-style-type: none"> Information collection link Based on VDS collection 	<ul style="list-style-type: none"> Node within the road(O-D, IC/JC, toll plaza) VDS Bridge's west/east approach bridge, both end of elevated bridge
3	<ul style="list-style-type: none"> Information provision link(provide information on traffic flow and congestion) Based on general information provision level 	<ul style="list-style-type: none"> Node within the road(O-D, IC/JC, toll plaza) Bridge's west/east approach bridge, both end of elevated bridge
Controllable information provision	<ul style="list-style-type: none"> Incident response link/Controllable information provision link Logical link system based on incident response that uses TSD 	<ul style="list-style-type: none"> Node within the road(O-D, IC/JC) TSD Bridge's west/east approach bridge, both end of elevated bridge

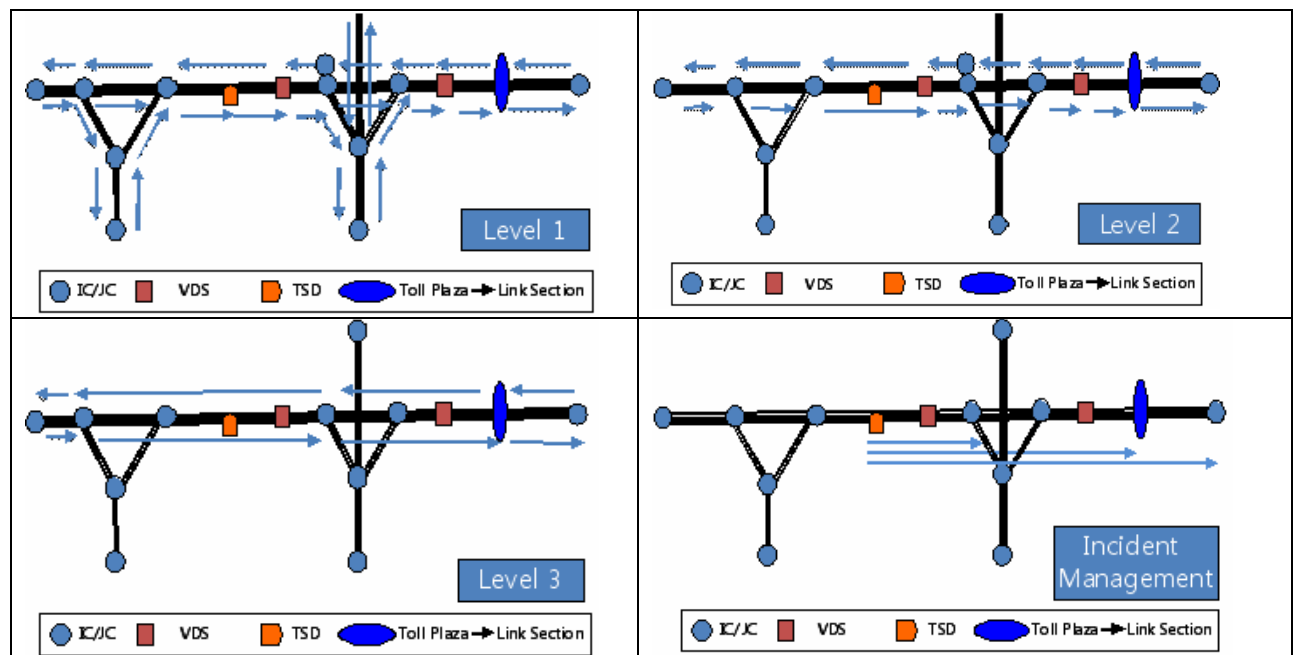


Figure 7. Node Link System by Level

2.10 Response Scenario by Traffic Situation

By configuring a scenario for each response plan by traffic situation, it can increase operator's understanding of response and by taking prompt and accurate response measures, it enables qualitative improvement in user service and increase in efficiency on traffic management system.

An appropriate scenario should be structured for each situation such as smooth traffic flow, congestion, incident situation, special situation and etc. and response scenario should be created in classification with the center, field, connection agencies and relevant agencies. It basically provides controllable traffic information through TSD/LCS and by properly using other traffic management systems, optimal traffic flow management should be performed.

In addition, on task area for each part, by creating scenarios according to the flow of event, enable systematic responses by operators and on overall response factors.

In case of smooth traffic flow, monitor the traffic flow of relevant road using CCTV images and collect VDS information to provide traffic flow status information on driving ahead. In addition, it basically provides information on Incheon Bridge guidance/promotion. Also, in advance management aspect, select black spots and constantly perform activities to prevent car accidents in advance.

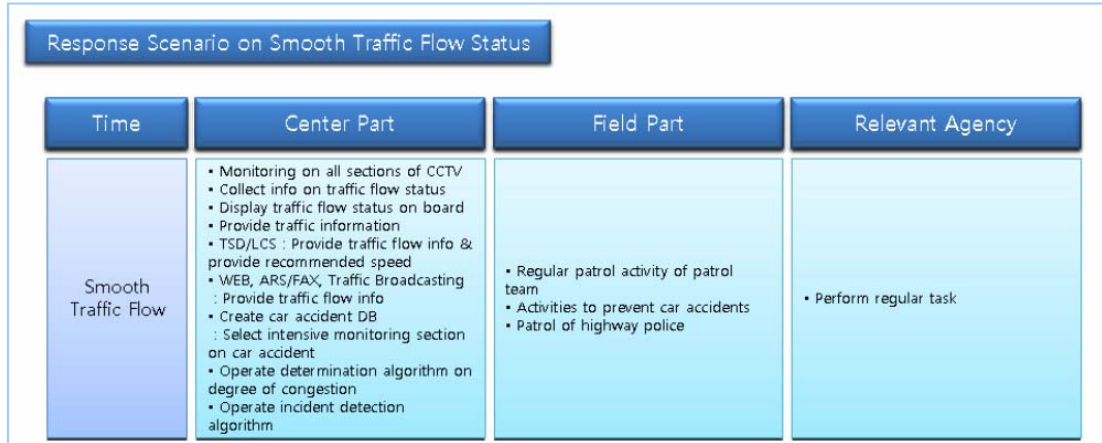


Figure 8. Example on Performance by Part in Smooth Traffic Flow

Example on Response Scenario

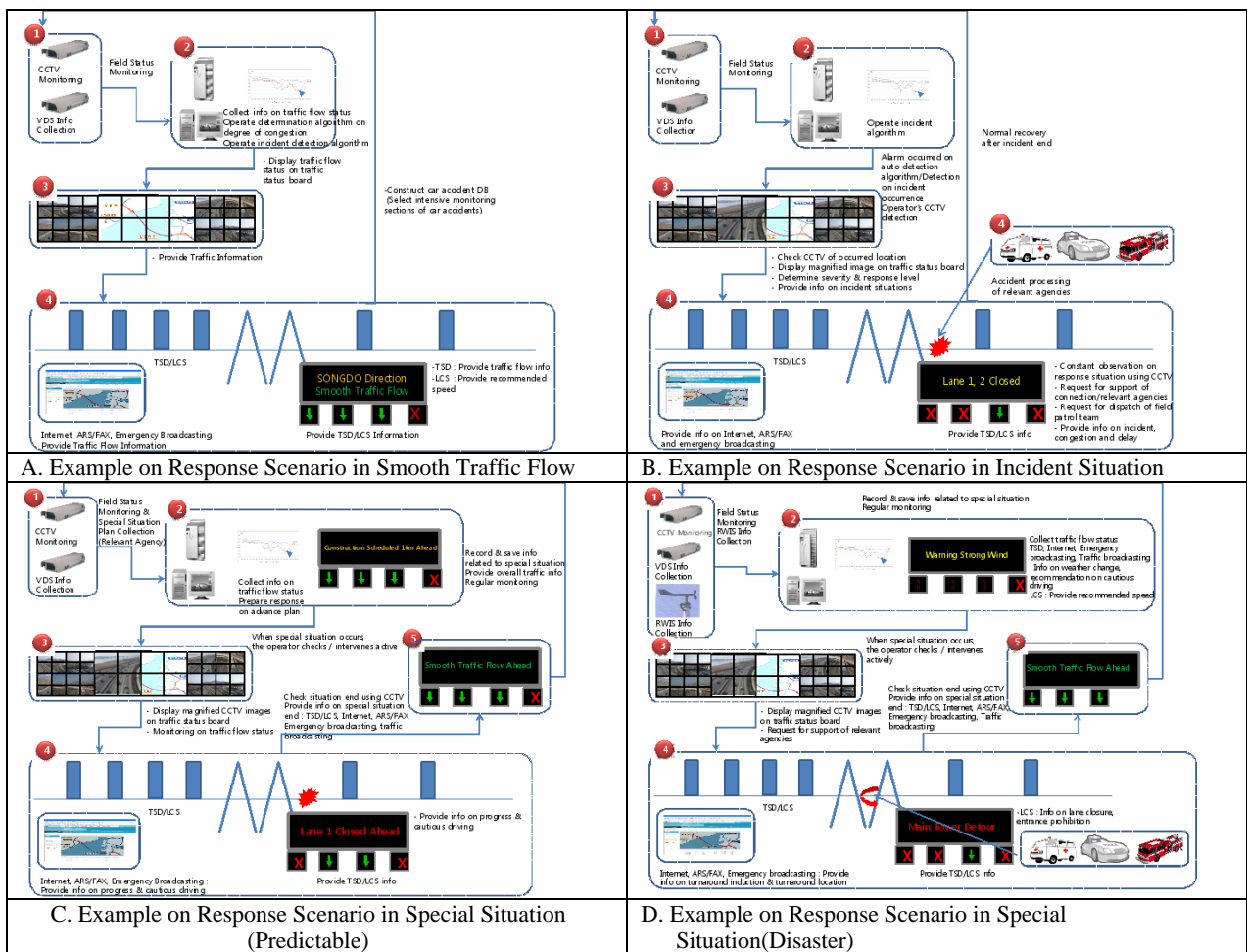


Figure 9. Example on Response Scenario